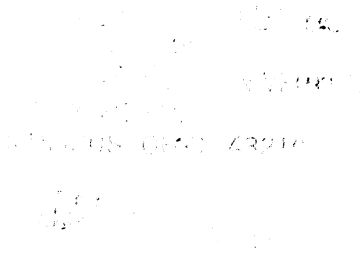
Economics and Sociology
Occasional Paper #615

TESTING AN OFF-FARM LABOR SUPPLY MODEL IN AN LDC

by

Dwight A. Smith*
and
Richard L. Meyer

May 15, 1979



* International Development Intern, Agency for International Development and Associate Professor, Department of Agricultural Economics and Rural Sociology, The Ohio State University, respectively. Part of the research reported in this article was supported by the Office of Rural Development and Development Administration, Agency for International Development. The usual disclaimer applies.

Agricultural Finance Program
Department of Agricultural Economics and Rural Sociology
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210

ABSTRACT

TESTING AN OFF-FARM LABOR SUPPLY MODEL IN AN LDC

Dwight A. Smith
Richard L. Meyer

A rural household model of off-farm labor supply is tested for the Philippines. Either husband or wife work off the farm in thirty percent of the surveyed households. Labor supply elasticity for households relative to off-farm wages approached four. Farm size had a negative effect on off-farm work.

Testing an Off-Farm Labor Supply Model in an LDC*

Dwight A. Smith and Richard L. Meyer**

INTRODUCTION

Most agricultural development strategies emphasize increasing farm income to reduce rural poverty. Recent studies, such as Fuhs and Vingerhoets, Hart, and Meyer and Larson, suggest, however, that off-farm earnings represent an important source of income for many low income rural households. Therefore, efforts to increase off-farm earnings may be an important way to improve rural welfare, especially in light of the disappointing progress made in accelerating small farm income.

Information about the labor supply response to rural off-farm employment is required before sound policies can be implemented. Two interrelated issues must be addressed. The first issue is the responsiveness of low income rural households to the wages offered in off-farm employment. The rationality of peasant households argued by Schultz has prompted many studies to test price responsiveness. Little work, however, has been done to test the extent to which time allocation in peasant households

---

* We are indebted to Professor Robert E. Evenson, Yale University, for suggestions and data used in this study, and to Professors Leroy Hushak, David Shapiro, Cristina David, Dale Adams, Robert Vogel for suggestions on this paper. Remaining errors are our responsibility.

** International Development Intern, Agency for International Development, and Associate Professor, Ohio State University, respectively.

is affected by off-farm wage rates. If the rationality argument holds, wage rates should influence off-farm labor supply. The second issue concerns the magnitude of the supply elasticities and, in particular, the income and substitution effects of higher wages.

The Philippine government has made increasing off-farm employment an explicit rural development objective (7). This paper reports the results of a labor supply model estimated with data drawn from a sample of Philippine households. It follows earlier work reported by Evenson. This study concerns one aspect of rural labor supply: the off-farm supply of farm households.[1/] The sample is limited to households which farm some land in the rice growing region of Laguna Province.

A MODEL OF TIME ALLOCATION

The home commodities model developed by Becker and extended by Gronau provides the basic theoretical framework for this research. When this theory is applied to farm households, the following assumptions are made: the family has a utility function and is a utility maximizer; the family has an accurate perception of the value of its nonmarket time; and no institutional constraints limit time spent in off-farm activities, that is, individuals face an elastic labor demand curve over the range of labor supply

---

1/ Off-farm employment is defined to include work on other farms, in side businesses, and in manufacturing and service activities.

considered. Following Huffman, it is assumed that, unlike off-farm work, additional time allocation to farm enterprises is subject to diminishing returns. Furthermore, the farm household is endowed with a given stock of capital, land, and labor, has a single period planning horizon, and has no overriding preference for farming.

The empirical model used in this study for husbands and wives was derived from a two-person household home commodities model. It is explained in detail in Smith. The estimated model is:

$$T_{Mh},\ T_{Mw} = f(W_{Fh},\ W_{Mh},\ W_{Fw},\ W_{Mw},\ V,\ E)$$

where T_{Mh} (T_{Mw}) measures the number of days worked off the farm by husbands (wives) for wages. The labor supply decision is considered two-dimensional: first, the decision to work off the farm, and then the amount of off-farm work. This variable is continuous where husbands (wives) not working off the farm are recorded as zero days.

W_{Fh} and W_{Fw} are estimates of the value of farm work obtained by asking respondents to specify the cost of replacing their farm labor with hired labor.[2/] The rates are weighted by the amount of time spent performing the task on the farm. An increase in the husband's (wife's) own on-farm wage rate (i.e., the marginal value of farm time) is expected to reduce his (her) off-farm labor supply. The effect on the husband's (wife's) off-farm labor time of an increase in the wife's (husband's) on-farm wage

---

2/ This concept is explained in Evenson.

is expected to be positive, if their time inputs are substitutes, and negative if they are complements.

W_{Mh} and W_{Mw} are imputed off-farm wage rates. A regression containing human capital attributes of age and education was estimated to obtain imputed wage rates. These imputed wages were used for all households to reflect potential income earning potential. The effect of a change in the husband's (wife's) off-farm wage on his (her) time allocated to off-farm work cannot be predicted since the term includes both income and substitution effects. An increase in the wife's (husband's) off-farm wage rate is expected to reduce the husband's (wife's) off-farm labor supply so long as time inputs are substitutes in home and market activities.

Nonearnings income (V) includes imputed returns to farm capital, net rental income and remittances. An increase in nonearnings income is expected to have a negative effect on off-farm labor supply so long as it is assumed that home time is a productive resource and home goods are normal goods.

E refers to a set of environmental variables which influence time allocation due to their relatively fixed nature. Farm size, measured in hectares, was included to reflect an implicit higher farm wage.[3/] Farm mechanization may have a positive effect on labor supply due to the possible substitution for family labor.

3/ Studies tend to show an inverse relation between farm size and off-farm employment. See for example (3, 8).

The stock of farm machinery was given as pesos per hectare. Size of dwelling would be expected to influence off-farm labor, especially for the wife in societies where home maintenance is largely a female task. Size of dwelling was measured in square meters.

No direct measure of home productivity was included in the survey data. Other research has attempted to account for home productivity by incorporating number and age structure of children in the analysis (2). Three variables for different age children were tested: number of children younger than 7 years of age, number between 7 and 15, and number older than 15. The presence of additional young children may encourage the husband to increase off-farm work to substitute for the wife's loss of income if she spends more time in child care. As children grow older, they cease being time-intensive commodities and begin to enter the household's time allocation. It is hypothesized that children first engage in home and farm production, then enter the off-farm market as possible substitutes for the parents' time.

Data for this research were obtained from 188 farm households selected from a larger survey conducted by the University of the Philippines. Recall data were obtained for the 12 month period ending April 1977. The households were originally selected at random from 26 rice producing barrios in the Province of Laguna for study in 1963 and 1968. From the total sample, households were selected for analysis that had both spouses present, farmed at least one-half hectare and the husbands were between 25 and 65 years of age.

RESULTS

Characteristics of Households

Table 1 reports selected time allocation and income information for the sample of households divided into four types. Husbands worked off the farm in 25 percent of the households, and wives in 12 percent of the households. Working husbands worked on the average just over 100 days regardless of whether their wives work. However, working wives work more than twice as many days off the farm when their husbands do not work off the farm. Children work a surprisingly large amount of time off the farm in all types of households, except where both husband and wife work off the farm suggesting a possible substitution of children for parents in home production. Children supplied almost 70 percent of the days worked off the farm and earned over 50 percent of total off-farm earnings. Unfortunately the data did not permit testing the effect of childrens' work on parents' off-farm work.

Households averaged about ₱ 10,000 (approximately US$1,500) in net household income (including home consumption of farm production), of which 13 percent was off-farm earnings. No significant differences were found in total income among household types, even though income tended to be lowest when only the husband worked off the farm, and highest when only the wife worked off-farm. In this latter case, children's earnings were also highest. Nearly 40 percent of household income was derived off-farm when both husband and wife had off-farm employment.

TABLE 1: Mean Values of Earnings and Days Worked Off-Farm by Type of Household, Sample Households, Laguna, the Philippines, 1976-77

Characteristic	Sample Mean	Type of Household[a/] (1)	(2)	(3)	(4)	F-Ratio[b/]
No. of Observations	188	127	38	13	10	13.997**
Days Worked Off-Farm						
By Husband	28.7	0	110	0	105	48.458**
By Wife	17.2	0	0	183	77	75.629**
By Children	91.7	101	75	111	16	1.179
Off-Farm Earnings[c/]						
By Husband	473	0	1361	0	3487	13.997**
By Wife	119	0	0	1173	652	58.978**
By Children	706	895	286	1291	54	1.286
Net Farm Income[d/]	8182	9013	6142	8790	5345	0.962
Household Income	9935	10354	8033	11762	10514	1.294

a/ The households are classified as follows: 1 = neither husband nor wife work off the farm; 2 = husband works off-farm, wife does not; 3 = husband does not work off-farm, wife does; 4 = both husband and wife work off-farm.

b/ F = $\frac{\text{Between Groups Mean Square}}{\text{Within Groups Mean Square}}$. The degrees of freedom are 3 and 184 for the numerator and demoninator, respectively. * = significant at the 0.05 level; ** = significant at the 0.01 level.

c/ Rounded to nearest peso. All earnings and income reported in Philippine Pesos. In 1977, 7 ₱ = 1 US dollar.

d/ Defined as the value of farm sales plus home consumption minus farm operating costs.

Regression Results

The regression model was estimated for both husbands and wives for different types of households. Space permits presenting only the model for husbands for all households. Table 2 presents one regression with only wage and income variables and a second which includes environmental variables. Tobit analysis was used to correct for the truncation associated with observations clustered at zero work days (11). Overall, the model gave surprisingly good results in spite of the obvious limitations in the data and the difficulty in measuring some of the variables. The test of significance for Tobit analysis, -2λ, indicates the hypothesis that all coefficients are zero can be rejected at the .01 level for the second model, but not the first.

The responsiveness of husbands to off-farm wage rates is shown by significant positive coefficients in both models. Thus, the substitution effect of wages outweighs the income effect. The elasticity approached 4 in the second model, suggesting highly elastic response by sample farmers to increased off-farm wages. Farm size has a significant negative effect on off-farm work as expected. Young children and older children are associated with more off-farm work as hypothesized. Husbands appear to substitute for the wife's off-farm work when she cares for young children. Later, as children grow older, they can engage in the production of home commodities thereby releasing the husband for more off-farm work. Coefficients for own on-farm wage rates, wife's on and off-farm wages, nonearnings income,

TABLE 2: Regression Coefficients and Related Statistics for Models of All Farm Husbands Using Tobit Analysis[a/]

Independent Variables	Regression (1)	Partial Elasticities	Regression (2)	Partial Elasticities
Intercept	-445.7642*** (2.62)		-435.9772*** (2.57)	
Husband's On-Farm Wage	0.2259 (0.49)	0.032	0.1824 (0.44)	0.030
Husband's Off-Farm Wage	17.3997** (2.17)	3.072	18.5587** (2.33)	3.791
Wife's On-Farm Wage	-1.0457 (1.22)	-0.125	-0.6111 (0.78)	-0.084
Wife's Off-Farm Wage	-1.5967 (0.11)	-0.079	1.6271 (0.12)	0.093
Nonearnings Income	-0.0029 (0.22)	-0.017	0.0089 (0.62)	0.060
Farm Size			-38.7082*** (2.53)	-0.986
Machinery			0.0031 (0.425)	0.049
Young Children			39.9757** (1.92)	0.254
Middle Children			0.6574 (0.06)	0.014
Older Children			8.8067*** (2.60)	0.215
Dwelling			-0.2420 (1.178)	-0.256
-2λ [b/]		6.242		29.171***
Predicted Probability of Off-Farm Work		0.246		0.214
Observed Frequency of Off-Farm Work		0.255		0.255
Expected Mean of T_{Mh} [c/]		27.1112		23.2276
Observed Mean of T_{Mh}		27.9046		27.9046

a/ The absolute values of "t" are shown in parentheses. These are not exact t-tests. They are asymptotically normal variables. The reference to "t-tests" is to provide an analog to ordinary least squares regression. * = signficant at 0.10 level; ** = significant at 0.05 level; *** = significant at 0.01 level.

b/ λ is the log of the likelihood ratio. For large n, -2λ is distributed chi-square with k degrees of freedom, where k is the number of explanatory variables in the regression other than the constant. This is analogous to an F-test on a vector of coefficients in standard OLS regressions.

c/ The expected mean of T_{Mh} is calculated at the mean of all explanatory variables.

machinery, number of children between seven and fifteen years, and size of dwelling were all insignificant variables affecting husband's labor supply; however, the signs were frequently as expected.

The predicted and observed probability of off-farm work, and expected and observed total labor supply are reasonably similar, providing additional confidence in the model.

Implications

These results suggest that small farmers in this area of the Philippines are responsive to off-farm wage rates in the allocation of household labor time. Farm and household characteristics, in addition to wage and income variables, are significant in explaining adjustments to off-farm wage rates. The differential between off-farm and on-farm earnings is expected to influence the amount of time devoted to farm and off-farm activities. This differential can arise in one of two ways. Pull factors exist when off-farm wage rates rise relative to opportunities to earn on-farm income. Push factors exist when increased household size and farm size fragmentation drive down household per capita income from farming.

These results are encouraging regarding the use of household economics in understanding and predicting behavior of low income rural families in LDCs. Refinements are required to incorporate wages and time allocation of children, and their impact on labor supply of adults. Time series data are needed to analyze the

dynamic process of adjustment and adaptation of rural households to expanded off-farm work opportunities. Of particular interest are the factors which determine the speed with which households react to these opportunities as this will determine future patterns of rural poverty and income distribution. Attitudes toward risk taking and preferences for off-farm work are likely to influence which households seek and obtain off-farm employment. A related issue concerns the factors which determine when members of a household choose to migrate rather than continue to maintain residence on the farm while spending substantial amounts of time in off-farm work. Successful off-farm work may prove to be an important step in the migration decision for some household members.

REFERENCES

1. Becker, G. S., "A Theory of the Allocation of Time," Economic Journal, Vol. 75, 1965, pp. 493-517.

2. Evenson, R. E., "Time Allocation in Rural Philippine Households," American Journal of Agricultural Economics, Vol. 60, 1978, pp. 322-331.

3. Fuhs, F. W. and J. Vingerhoets, Rural Manpower, Rural Institutions, and Rural Employment in Thailand, Manpower Planning Division of the National Economic Development Board, Thailand, 1971.

4. Hart, G., "Patterns of Household Labor Allocation in a Javanese Village," revised paper prepared for the ADC-RIN Workshop on Household Studies, Singapore, August 1976, Department of Agricultural Economics, Cornell University, Ithaca, New York, February 1977.

5. Gronau, R., "The Interfamily Allocation of Time: The Value of the Housewife's Time," American Economic Review, Vol. 63, 1973, pp. 634-651.

6. Huffman, W. E., "A Cross-Sectional Analysis of Non-farm Work of Farm Family Members," a study completed for the Manpower Administration, U.S. Department of Labor, Iowa State University, Ames, Iowa, 1976.

7. International Labour Organization Report, Sharing in Development: A Program for Employment, Equity and Growth for the Philippines, Geneva, 1976.

8. Meyer, R. L. and D. W. Larson, "Rural Nonfarm Employment: The Recent East Asian Experience," Journal of Economic Development, Vol. 3, No. 1, July 1978, pp. 91-112.

9. Schultz, Theodore W., Transforming Traditional Agriculture, Yale University Press, New Haven, 1964.

10. Smith, Dwight, "The Determinants of the Off-Farm Labor Supply by Small-Farm Household Members: The Case of Laguna, the Philippines," unpublished M.S. thesis, Ohio State University, 1978.

11. Tobin, J., "Estimation of Relationships for Limited Dependent Variables," Econometrics, Vol. 26, 1958, pp. 24-36.